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Ancillary Benefits of Climate Policy

New Theoretical Developments and Empirical Findings

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Foreword

Do we need ambitious climate policies to create a good future for humanity? We clearly do—such goes the premise that has given rise to rounds and rounds of global negotiations spearheaded by the United Nations. This process has now entered its fifth decade since its genesis: the First World Climate Conference was held in February 1979, then organized by the UN's meteorological organization. Lately, global climate diplomacy has developed a momentum that many could not foresee. It produces regulations and voluntary commitments aimed at all the world's countries, and both the EU and Germany have already made concrete pledges to contribute. The Fridays For Future youth demonstrations have been mobilizing young people in more than 120 nations. Climate change is at the top of the political agenda, and many industry players have ceased to resist the development and begun instead to promote predictable, efficient climate policies.

But the countermovement is gaining traction, too. The USA, the world's largest economy, has recently announced its withdrawal from the Paris Climate Agreement next year. Brazil appears to be wavering on the issue of climate protection, while populist parties openly question the entire concept in many countries. Should we do nothing instead? Some believe that idleness is indeed the best approach, and their voices grow louder by the day. The Internet with its ubiquitous echo chambers and climate change denial blogs amplifies them effectively. Politicians have no choice but to take these factors seriously: climate policy is about much more than the climate itself. It is about democratic legitimacy and, not infrequently, about political survival.

The onus is on those in charge to navigate the ongoing struggle among the various factions of global civil society and make the right promises. Those promises must be ambitious enough that they can inspire voters and stakeholders to embrace change. At the same time, they must be realistic enough to prevent a crisis of legitimacy in the climate protection movement: their benefits must be clearly defined and put in perspective to their costs; feasible future approaches must be presented in accessible ways. Situated at the intersection between science and politics, climate research carries out crucial groundwork to facilitate progress.

This book is a valuable contribution to its efforts. It provides a realistic overview of the ancillary benefits (or co-benefits) of climate protection: the positive “side effects” of climate policy beyond their immediate chain of effects (lower greenhouse gas emissions—less climate change—less damage to the climate). In the heat of political discourse, these effects are often used as a pretext for careless, even false promises: transforming our energy system will bring about better jobs, greener parks, cleaner air, greater democracy, and so on. Such hollow words are easily debunked by opponents of climate protection and ultimately contribute little to the cause. The following selection of research papers by authors from four continents provides a scientific assessment of these co-benefits. Their findings establish a solid basis for convincing arguments, which may well encourage policymakers to dare take ambitious action.

Explaining the benefits of climate policy can be tricky: after all, its purpose is to prevent or lessen something that is negative, poorly understood, and difficult to quantify. Demands for ambitious measures can easily take a negative tone, as arguments emphasize the “threat” of climate change. But society is increasingly aware that the excessive exploitation of global resources, such as the atmosphere, spells trouble for prosperity in the twenty-first century. In turn, the fair and efficient use of global resources secures prosperity. But in the twenty-first century, the notion of prosperity must be different to that of the preceding two centuries. It is this hypothetical new idea of prosperity that will allow us to quantify the co-benefits of climate policy adequately.

This work skillfully highlights the importance of the Sustainable Development Goals in this context. Ending poverty, securing food, and giving everyone access to healthcare and education are demands and guiding principles that fuel political debate and motivate voters and politicians alike. Research into the co-benefits of climate policy has inspired important discussions in welfare states such as Germany, showing clearly that society is interested in fair income distribution, healthy ecosystems, and sustainable consumerism. Ultimately, this book employs specific scientific perspectives to discuss a very simple, fundamental topic: climate policy as a guarantor of a high standard of living.

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Preface

While concerns about accelerating global warming preoccupy the public—as one can observe from the recent school strikes as protest against too few climate protection efforts—the Paris Agreement on Climate Change is starting to take effect in several areas of our planet. Yet, while in Europe, levels of carbon dioxide emissions are declining, in order to reach the 2° goal and even more the 1.5° goal of the agreement, global climate protection efforts have to be strengthened considerably. This becomes even more urgent as concentrations of methane, which is another very potent greenhouse gas besides carbon dioxide, have increased in an unexpectedly strong way in recent years.

Owing to the vital need for action to protect the climate, there have been intensive efforts to find additional incentives to raise protection levels. Apart from the generation of incentives via policy instruments like emission trading schemes, climate policy has other effects, so-called ancillary effects, which tend to raise the attractiveness of climate protection. The aim of this volume is to deal with these effects and the various associated benefits for economy and society.

The fact that besides its underlying objective a policy measure may have other impacts has regularly been present in the research of the editors of this volume, even beyond the context of environmental protection. We have addressed such issues in different ways, and in doing so, we have included the implications of different degrees of "publicness" or the extent to which the ancillary effects take the form of a public good. Inspired by this research and the high relevance of these issues for climate policy, we had the idea to compile a book including recent research concerned with joint production effects. Although the chapters in the book focus on the joint effects of climate policy, it is straightforward to apply the models and techniques used in this book also to joint production in other fields, for instance to research on philanthropy, performing arts, green goods consumption, terrorism, and military alliances.

In the process of drafting and publishing this book, many people were involved to whom we owe our thanks. We are in particular grateful to Theresa Stahlke who supported us in organizing the submission and review processes. She also gave valuable comments on several parts of this book. We would also like to thank

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Financing Forest Protection with Integrated REDD+ Markets in Brazil

Ronaldo Seroa da Motta, Pedro Moura Costa, Mariano Cenamo, Pedro Soares, Virgílio Viana, Victor Salviati, Paula Bernasconi, Alice Thuault, and Plinio Ribeiro

1 Introduction

It is widely recognized that Brazil has achieved a great degree of greenhouse gas (GHG) abatement. In 2017, GHG emissions in Brazil were 17% lower than in 2000, despite the increase in the economic output of over 70% in the same period (SEEG 2019).

This was achieved mainly due to successful forest management policies that have reduced the deforestation rate by 75% since 2002. The Intended Nationally Determined Contributions (INDC) outlined by Brazil in the UN Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in

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December 2015 is even more ambitious and has a commitment to reduce nationwide emissions from forest fire and logging by 90% by 2030.

It is important to highlight that this successful forest policy changes to curb deforestation in Brazil were not initiated to pursue carbon mitigation targets. The main motivation was to protect forest ecosystem services.

Deforestation has negative effects on plant and animal species found in the rainforest. In the case of the Amazon Region, one of the most diverse forests on Earth, such species loss has quite a high social cost.

At least 40,000 plant species, 427 mammals, 1300 birds, 378 reptiles, over 400 amphibians, and around 3000 freshwater fish have been found in the Amazon (Silva 2005). In Brazil alone, between 96,660 and more than 100,000 invertebrate species have been described by scientists (Lewinsohn and Prado 2005).

Many of these species are not found anywhere else in the world. ter Steege et al. (2015) estimated using overlay spatial distribution models with historical and projected deforestation that at least 36% and up to 57% of all Amazonian tree species are likely to qualify as globally threatened under the International Union for Conservation of Nature (IUCN) Red List criteria. If confirmed, these results would increase the number of threatened plant species on Earth by 22%. These authors also indicated how remaining areas of undisturbed and recovering forest provided the last refuge for many species unable to withstand the impact of human activity. Therefore, conserving existing secondary forests may be much cheaper and even more efficient than planting trees to maintain the ecosystem services.

Strassburg et al. (2012) show that adequately funded and broadly implemented carbon-based forest conservation could play a major role in biodiversity conservation, as well as in climate change mitigation.

In addition to non-use values attached to biodiversity, there are important local use values that are also highly dependent on forest management. Malhi et al. (2008) show that evaporation and condensation over the Amazon serve as engines of the global atmospheric circulation, with downstream effects on precipitation across South America and further afield across the Northern Hemisphere. And deforestation exacerbates ecosystem feedbacks such as forest dieback and reduced transpiration.

Paiva et al. (2013), for example, demonstrate that surface waters dominate total water surface variation for the whole Amazon area with a fraction of 56%, followed by soil (27%) and ground water storages (8%).

Floodplains also play a major role in stream flow routing. As stated by Sumila et al. (2017), the Amazon then helps regulate the regional humid climate that affects economic activities that depend on it, such as agricultural productivity and hydropower generation. These effects, according to the authors, are stronger during the onset of the rainy season than when the season is fully developed. Therefore, it leads to less rainfall in the transition months or even a delay in the onset of the rainy season, as deforestation progresses.

The values of these benefits are not priced but are valuable as already pointed out by several studies (Andersen et al. 2002; Seroa da Motta 2005). Strand et al. (2018) have recently estimated economic values for a range of ecosystem services provided by the Brazilian Amazon forest, including extractive production, greenhouse gas mitigation and climate regulation effects on agriculture, cattle raising, and hydroelectricity production. Their highest estimated values range from US\$56.72 $\pm$ 10 ha^{-1} $year^{-1}$ to US\$737 $\pm$ 134 ha^{-1} $year^{-1}$.

The achieved reduction in the deforestation rate in Brazil has contributed to capturing part of these benefits. It has done so by combining control instruments to improve the monitoring system and strengthening sanction enforcement on forest management, plus restrictions to agricultural expansion in the region, reduced access to agricultural credit and markets, and forging supply chain voluntary actions not to use illegal deforested areas.

However, it has been already pointed out that the incentive power of these control measures has reached its limit and the continuation of the successful pathway may require a more complex set of incentives. Pricing these benefits of ecosystem services in forest conservation must then play a key role in the designing of conservation strategies (Strand et al. 2018; Gibbs et al. 2015; Nepstad et al. 2014; Barreto and Araujo 2012; Hargrave and Kis-Katos 2013).

One instrument is to count on payments for the performance on the reduction emission of forest deforestation and degradation (REDD+). Most tropical forest-rich countries are already designing their REDD+ strategies, while developed countries are in turn requested to scale up respective short- and long-term financing. In most cases, REDD+ strategies will need to draw on customized policy mixes to become effective.

The chapter extends the analysis of a proposal of an Integrated REDD+ approach to fit into Brazil's REDD strategies that was initially presented in Costa et al. (2017). The next section presents the REDD+ framework within the UNFCC and addresses its main additionality concerns. The third section overviews REDD+ markets, and its following section presents details of the proposed Integrated REDD+ approach. The last section concludes the matter.

2 The REDD+ Approach

Since deforestation accounts for more than 15% of global GHG emissions, there is an interest in funding mechanisms to reduce emissions from deforestation and forest degradation. Article 5 of the Paris Agreement (United Nations 2016) reinforces the REDD decisions already agreed under the Climate Convention.

This article contains two paragraphs. The first emphasizes the decision to encourage actions to conserve and improve sinks and reservoirs of greenhouse gases, including forests, as appropriate.

The second paragraph encourages measures to implement and support, together with results-based payments, the guidelines, and decisions that have been already approved for activities related to emission reductions from deforestation and degradation, as well as conservation, sustainable management, sustainable forest management, and increased forest carbon stocks in developing countries. It also includes joint mitigation and adaptation approaches for the integrated and sustainable management of forests, reaffirming the importance of encouraging the other benefits in addition to non-carbon benefits associated with such approaches (Seroa da Motta 2018).

REDD+, however, faces the technical issues that are common to any credit-based offset mechanism. These arise from the potential variability of definitions of what changes in emissions should be credited to the project and how. The validation difficulty is related to baselines, detecting leakage, and the mensuration of carbon sequestration or release from biomass, all of which have been quoted as creating uncertainties about the climatic impacts of REDD+.

Leakage may occur when the funding of reductions in deforestation and degradation in one particular place leads to more trees being cut down in other forest areas. Such possibility may not guarantee additionality, that is, reduced carbon emissions would have occurred even without REDD+ payments. Forest preservation also faces permanence risk when carbon is just temporarily stored in the forests since there is no guarantee that this stored carbon will not be emitted in the future because of economic destructive activities or natural hazards (Moutinho and Guerra 2017; Agrawal et al. 2011; Paoli et al. 2010; Aukland et al. 2003).

Baseline and credit schemes have proven uncertain in relation to baseline definition and leakage when the flow-avoided deforestation is the credit. On the other hand, if the remaining forest stock (i.e., remuneration for any standing biomass) is to be given credit to avoid leakage, it would create an oversupply that could not be priced.

Therefore, the stock and flow method provide a balanced approach when payments are split into stock and flow credits. Payments to forest stocks create the incentives to past protection and flow payments to incentivize avoided deforestation. Carbon balance is made by jurisdiction level where reduced flow of emissions from deforestation and degradation below a historical reference emissions level would be eligible for payments. And carbon balance will have to be deducted from the country's national carbon balance sheet.

With this approach, REDD+ financing has moved away from project-based REDD+ activities toward jurisdictional and nested programs that cover national and sub-national levels (Moutinho and Guerra 2017).

Regarding validation, scientific evidence has been produced to overcome these concerns, and with the improvement of remote sensing and other monitoring technologies, these technical impediments have been mostly overcome (Watson et al. 2010).

Also, the evolution of guidelines and standards such as the Verified Carbon Standard (VCS),[1] the Climate, Communities and Biodiversity (CCB),[2] and the Warsaw

[1] www.v-c-s.org/project/vcs-program/

[2] www.climate-standards.org/ccb-standards/governance-of-the-standards/

Framework for REDD are ensuring that REDD+ projects generate comparable climatic benefits while creating other social and environmental co-benefits.[3]

Provided that GHG emission reductions generated by REDD+ initiatives are accounted for in a consistent way, between countries and within projects, programs and national initiatives within countries, REDD+ could become a robust GHG mitigation option.[4]

Developing country Parties implementing REDD+ activities should periodically provide a summary of information on the outcomes of activities related to REDD+, including activities on capacity building, demonstration activities, addressing drivers of deforestation, and mobilization of resources, that is, a transparent REDD + national strategy. This strategy and results should be included in national communications or be provided, on a voluntary basis, via the REDD+ Web Platform.

On December 2, 2015, the Brazilian Ministry of the Environment, through Ordinance No. 370, established the National REDD+ Strategy, designated by the acronym in Portuguese ENREDD+, based on the jurisdictional approach.

ENRRED's main goal is to integrate the governance structures of climate change, forest, and biodiversity-related policies, seeking to promote consistency and synergies among them at the federal, state, and municipal levels.

However, at least in its first phase, funding options do not allow REDD credits to be used as offset in other countries' NDCs. This position is mainly justified on the ground that such an approach generates a very large supply at very low costs, thus reinforcing the identified fears of reduction in the attractiveness of local mitigation actions.

Nevertheless, despite supply and demand management, REDD+ will compete with the sustainable development mechanism (SDM) that has been proposed in Paragraphs 6.4 and 6.7 of the Paris Agreement. This mechanism was based on one Brazilian initiative to replace the Clean Development Mechanism (CDM), and it includes incorporating modalities, procedures, and methodologies to allow for the negotiation of Certified Emissions Reduction units (CERs).[5]

Inspiration from the CDM has shifted to Paragraph 4 (a) of the Paris Agreement (United Nations 2016), which highlights the promotion of GHG emissions mitigation in order to strengthen sustainable development. And Paragraph 4 (b), much like

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[3]Warsaw Framework for REDD+, http://unfccc.int/land_use_and_climate_change/REDD+/items/8180.php

[4]Indeed, this approach has been considered by the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) initiative of the International Civil Aviation Organization (ICAO), i.e., to require that land use projects supplying credits to the scheme must be in conformity with the Warsaw Framework and ensure the harmonization of baselines between projects, jurisdiction, and nations. www.icao.int/environmental-protection/Pages/market-based-measures.aspx

[5]For a more detailed discussion on the differences and similarities between the CDM and the SDM, please refer to Greiner et al. (2017) and Seroa da Motta (2018).

the CDM, states that the mechanism should encourage and facilitate participation in greenhouse gas emissions mitigation by authorized public and private entities.

The Brazilian proposal (Brazil 2014) has also proposed that the mechanism be established to assist mitigation efforts of target countries and assist developing countries in implementing project activities with the aim of reducing GHG emissions or increasing removals by sinks. Consequently, all countries could emit SDM-certified emission reductions, and the scope could cover a wide range of activities, including those associated with sinks (Seroa da Motta 2018; Marcu 2016; IETA 2016).

Paragraph 6.4 (c) seems to confirm this possibility, as it refers to mitigation activities and the reduction of emission levels by the generating country, reaffirming in Paragraph 6 (d) that the SDM should "provide global mitigation in global emissions." Thus, along these lines, it would be possible to integrate a CDS range of activities with the REDD mechanism, as discussed as follows.

3 The REDD+ Market

Increasing urgency required to prevent catastrophic climate change requires the integration of all greenhouse gas (GHG) mitigation options and sectors in parallel. The creation of a carbon price is essential for the decarbonization of energy generation, industrial processes, transportation modes, and consumer patterns.

The process of price formation, however, breaks down if an oversupply of cheap mitigation options is mixed with measures that require higher carbon prices to compete. This has been the dynamic between land use mitigation options, in particular REDD+, reducing emissions from deforestation and forest degradation in relation to industrial and energy options. If REDD+ is included in markets, however, the potential oversupply of this mitigation option could reduce prices to an extent that there could be no financial incentive for promoting action on industrial improvements, energy efficiency, or renewable energy.

The easy solution, adopted since the outset of the Kyoto Protocol in 1997, has been to exclude REDD+ from markets. Land use, however, is still responsible for ca. 24% of global GHG emissions,[6] and as already said for playing a vital role in biodiversity conservation, water flows, and livelihoods. With no carbon pricing to support it, significant levels of deforestation and GHG emissions have occurred from 1997 to date. The exclusion of forests, therefore, resulted in a missed opportunity to create financial incentives for promoting the reduction of deforestation.

Looking forward, it is essential that developing countries secure financial resources to ensure forest protection in order to meet their GHG emission reduction targets under the Paris Agreement (United Nations 2016). The INDCs[7] of many

[6]https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

[7]NDCs (Nationally Determined Contributions) are the GHG emission reduction targets assumed under the Paris Agreement.

tropical forest countries are heavily reliant on the reduction of deforestation and ensuring land use sustainability. In the case of Brazil, for instance, 89% of its NDC emission reductions are expected to derive from reduced deforestation (Piris-Cabezas et al. 2016). However, while government budgets to environmental protection have been severely cut,[8] to date the only source of external funding available to support this effort in Brazil has been ODA transfers, predominantly from Norway and Germany.

At the same time, if REDD+ is adopted, the large volumes of emission reductions with low unit cost would reduce the average costs of abatement and provide an incentive for countries to adopt more ambitious reduction targets.

There is an urgent need to conciliate the tensions and requirements of creating a carbon price for both REDD+ and other sectors of the economy, and secure long-term financial support for the protection of forests at a large scale. This integration of forest protection, production, and wider economic objectives would make it more cost effective and feasible to promote large-scale GHG mitigation and global decarbonization with the participation of all sectors of the economy.

Market concerns, however, remain valid, because of supply and demand unbalances. Land use practices have the potential to generate large volumes of GHG mitigation at low prices (Seymour et al. 2017; Edwards 2016). The implementation of the new Brazilian Forest Code, for instance, has the potential to conserve over 250 million ha of native vegetation in Brazil, storing ca. 100 $GtCO_2e$—the equivalent of 45 years of the European Union's industrial complex operating without caps (Britaldo et al. 2014). Tropical peatlands, in turn, currently store carbon equivalent to 5–9 years of global GHG emissions and their degradation is responsible for ca. 10% of global emissions (Kurnianto et al. 2015).

Global demand for GHG reductions, on the other hand, remains restricted due to the lack of binding commitments of international agreements. While the Paris Agreement points in the right direction, it does not create any binding commitments. California's market has the potential to absorb 225 $MtCO_2e$ of international offsets, and targets in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) could create a demand of 3 ca. Gt by 2035.

Unbounded supply of REDD+ units would result in low prices that could derail efforts to enhance endogenous technical changes in the decarbonization of the industrial, energy, agricultural, and transportation sectors. So, there is a need to control the supply of REDD+ units in markets, to the extent that it does not preclude other mitigation options. If managed properly, the relatively lower cost of REDD+ could enable the adoption of more ambitious deforestation control targets and involve all sectors of the economy.

[8]See, for instance, in the case of Brazil, the 2017 reduction of 51% in the budget of the Brazilian Ministry of Environment—www.observatoriodoclima.eco.br/ministerio-do-meio-ambiente-perde-51-da-verba-apos-corte/

4 Integrated REDD+[9]

Given that the inclusion of emission reductions from REDD+ in the same market as other mitigation options could result in undesirable impacts, a possible solution would be to create two distinct but complementary markets. REDD+ units should be negotiated in a pool of other REDD+ units, so as not to affect the pricing of other mitigation options. At the same time, nations or entities should not be allowed to meet their targets solely through the use of REDD+ units, but also by adopting a combined approach.

For instance, a first tranche of a country's target should be met by adopting internal decarbonization measures and/or non-REDD+ offsets, such as public policies and incentives for energy efficiency, renewable energy, improvements in industry and transportation, etc. Only after this "quota" is met could this same country complete its targets using REDD+ offsets.

A similar conditional approach to the conditional use of offsets was adopted by the European Union Emissions Trading System (EU ETS) where the "supplementary" concept required countries to meet only a proportion of their targets using offsets. This proportion celling was justified to keep carbon price incentives to technical change on energy and industrial mitigation options (Trotignon 2011).

The identification of the REDD+ share is also needed and should be the one equalizing the marginal ancillary benefits of REDD+ to the marginal cost of reducing the technological externalities from mitigation options on energy and industrial sources. Measuring these marginal benefit and cost curves are not trivial but proxies and references of them must be the departure points. Political economy factors must enter only to balance their estimation uncertainty (Wang-Helmreich and Kreibich 2019).

Figure 1 shows how integration would work with separate but complementary carbon markets, so that REDD+ units would not affect the price levels of other mitigation mechanisms. They would be supplementary requirements both in terms of domestic abatement measures and external offsets, but also between REDD+ and other types of mitigation mechanisms.

A series of positive impacts could be expected by adopting this approach:

- The separation of markets would not reduce the price of other mitigation options.
- By ensuring that non-REDD+ options receive the necessary financial resources to direct investment in R&D and investment in low-carbon infrastructure, the process of innovation and decarbonization of industrial, transportation, and energy complexes would continue.
- Including REDD+ units as a complement to these measures, however, would reduce the average cost of GHG abatement and enable countries/entities to adopt more ambitious targets.

[9]This proposal was initially presented in Costa et al. (2017).

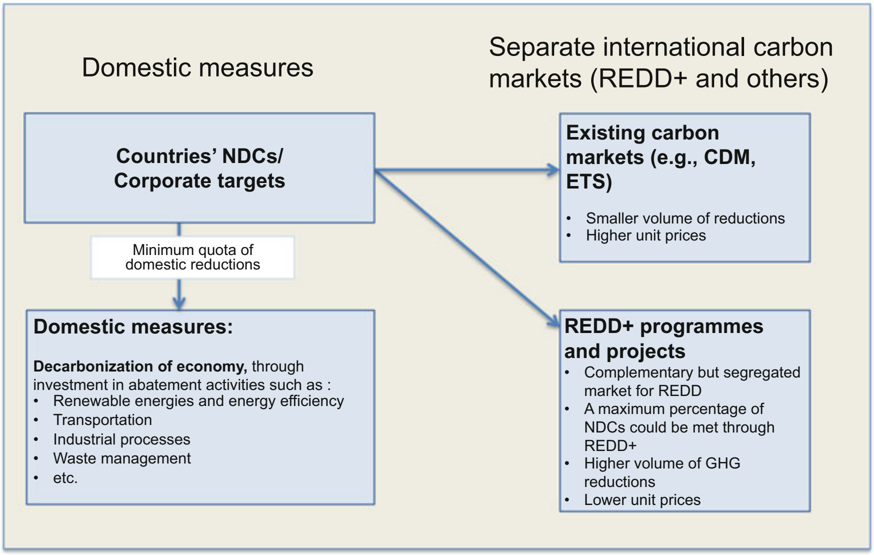

Fig. 1 Integrated REDD+ concept in markets

- The inclusion of REDD+ in markets, at the same time, would ensure access to financial incentives to tackle this important source of emissions.
- Given that the abatement profile of reducing deforestation is frontloaded (as opposed to tree planting or the replacement of energy infrastructure, for instance), it would accelerate the climate benefits associated with mitigation, "buying time" for other measures to enter into force.

Therefore, we propose in this chapter that the design of a future global carbon market regime include REDD+ in its mix, by adopting separate but complementary markets to ensure that forest protection, land use production, and decarbonization of other economic sectors occur in parallel—an integrated protection, production, and decarbonization market—"Integrated REDD+."

At the local scale, the implementation of REDD+ can create tensions with other land use activities. Tree planting schemes envisage carbon finance to finance their plantings. Agriculture, a major deforestation driver, requires finance to intensify and reduce its impacts. Sustainable land use, however, requires the combination and integration of these different measures, which in turn have different carbon benefits, timeframes, and costs.

By allowing all these activities to compete for financial resources in the same playing field, it is unlikely that costlier alternatives would succeed. However, it is the combination of approaches that ensure a sustainable landscape integrated with a productive rural economy.

As proposed for the design of international carbon markets, REDD+ finance flows at the country or jurisdictional level could be conditioned to parallel investments in complementary activities, adopting a "stocks and drivers" approach. That is, for each investment in forest protection, there should be a complementary investment in tackling the drivers of deforestation (predominantly, intensification of agriculture to reduce pressure on land) and/or reforestation of riparian reserves or water catchments.

Figure 2 shows how the integration with other activities within developing countries would ensure combined incentives of forest protection, sustainable agricultural production, and decarbonization of the economy as a whole.

The management of these contributions to land use sustainability at the landscape level could be done by programs themselves or through funds managed by government agencies based on jurisdictional REDD+ programs ensuring this distribution of resources.

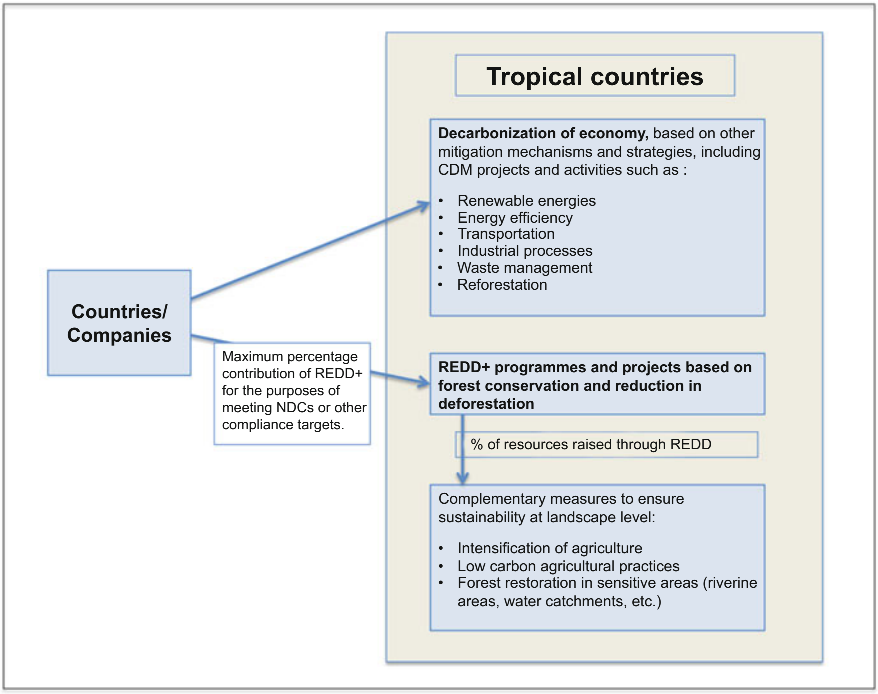

Fig. 2 Integrated REDD+ concept in activities

5 Final Remarks

The urgency in talking about GHG emission mitigation and avoiding climate change requires a concerted and integrated effort involving all sectors of the economy. Given its importance in terms of contribution to GHG emissions, the land use sector must be able to secure financial resources in a large scale to ensure its sustainability and transition to a low-carbon dynamic.

Ancillary benefits are enormous when forest protection contributes in the combat of global warming. The unique biodiversity of tropical forests, as is the case of the Amazon Forest, carries non-use value to the entire world.

In addition to the non-use values attached to biodiversity, water flow use values are also highly dependent on forest management. For example, evaporation and condensation over the Amazon serve as engines of the global atmospheric circulation, with downstream effects on precipitation across South America and further afield across the Northern Hemisphere. In Brazil, it has helped the regional humid climate that affects economic activities that depend on it, such as agricultural production and hydropower generation.

The inclusion of REDD+ into markets is an opportunity to secure such climate and ancillary benefits, directing financial resources to the land use sector.

Since the high volume of reductions and low unit costs of REDD+ units have the potential to create market unbalances and affect the carbon price of other important GHG mitigation activities, we propose herein the creation of a separate market for REDD+ units, associated with a supplementary requirement, so as to ensure the continuation of investments in other mitigation activities.

The creation of a separate REDD+ market has the potential to catalyze the transfer of financial resources to the land use sector, while ensuring that non-REDD+ options continue to receive financial resources for the innovation and decarbonization of industrial, transportation, and energy activities.

Given the low unit cost of REDD+ units, its inclusion in markets would reduce the average cost of GHG abatement and enable recipient countries/entities to adopt more ambitious targets in emission reduction, therefore securing valuable forest ecosystem services.

Ancillary benefits would not only add value to the world as a whole but will also largely benefit national and regional economies in supporting water flows regarding urban and rural supply and hydroelectricity. If so, such gains may attract domestic public and economic support to global warming combat actions.

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